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## Two observational studies examining the effect of a social norm and a health message on the purchase of vegetables in student canteen settings

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### ABSTRACT

There is some evidence from laboratory-based studies that descriptive social-norm messages are associated with increased consumption of vegetables, but evidence of their effectiveness in real-world settings is limited. In two observational field studies taking an ecological approach, a vegetable-related social norm (e.g. “Did you know that most students here choose to eat vegetables with their meal?”), and a health message (e.g. “Did you know that students who choose to eat vegetables have a lower risk of heart disease?”) were displayed in two different student canteens. Purchases were observed during three stages: baseline, intervention (when the posters were displayed) and immediate post-intervention (when the posters had been removed). Study 1 ( $n = 7598$ ) observed the purchase of meals containing a portion of vegetables and Study 2 ( $n = 4052$ ) observed the purchase of side portions of vegetables. In Study 1, relative to baseline, the social-norms intervention was associated with an increase in purchases of vegetables (from 63% to 68% of meals;  $OR = 1.24$ ,  $CI = 1.03$ – $1.49$ ), which was sustained post-intervention (67% of meals;  $OR = 0.96$ ,  $CI = 0.80$ – $1.15$ ). There was no effect of the health message (75% of meals at baseline, and 74% during the intervention;  $OR = 0.98$ ,  $CI = 0.83$ – $1.15$ ). In Study 2, relative to baseline, there was an effect of both the social norm (22.9% of meals at baseline, rising to 32.5% during the intervention;  $OR = 1.62$ ,  $CI = 1.27$ – $2.05$ ) and health message (rising from 43.8% at baseline to 52.8%;  $OR = 0.59$ ,  $CI = 0.46$ – $0.75$ ). The increase was not sustained post-intervention for the social norm intervention (22.1%;  $OR = 0.59$ ,  $CI = 0.46$ – $0.75$ ), but was sustained for the health intervention (48.1%;  $OR = 0.83$ ,  $CI = 0.67$ – $1.02$ ). These results support further testing of the effectiveness of such messages in encouraging healthier eating and indicate the need for larger-scale testing at multiple sites using a randomised-controlled design.

### 1. Introduction

Low levels of fruit and vegetable consumption have been associated with an increased risk of a variety of diseases, including cardiovascular disease, certain cancers and stroke (Aune et al., 2017). The World Health Organisation reported insufficient fruit and vegetable intake as a significant contributing factor for 2.8% of deaths globally (WHO, 2002). There have consequently been a number of attempts to encourage the general public to increase consumption of fruit and vegetables, including long-running campaigns, but there has been little

change in reported consumption over the last decade (Bates et al., 2014). Consequently, it remains the case that only 30% of adults meet the recommended five portions of fruit and vegetable per day within the UK (Public Health England & Food Standards Agency, 2014), and according to an analysis of the eating habits of adults aged 35 years or over within the Health Survey for England, 15% reported consuming 1 portion or fewer of fruit and vegetables the previous day (Mindell et al., 2012). A review of such campaigns suggests that the impact of those adopting an informational or health-focused approach is modest (Rekhy & McConchie, 2014), and may result in a “boomerang effect”, in which

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public-health campaigns inadvertently encourage the behaviour they are trying to reduce (Byrne & Hart, 2009; Cho & Salmon, 2007). One reason is that the complex nature of nutritional choices, and the action one should take, is difficult to condense into such campaigns. Moreover, information alone is not always enough to motivate people to change their behaviour, especially when the recommended behaviour runs counter to personal preferences and environmental influences (Guthrie, Mancino, & Lin, 2015). Attention has therefore shifted towards other ways in which individuals can be supported in making healthier dietary choices, in particular, through utilising social processes.

It is well established that what (and how much) people eat is influenced by social norms (Herman, Roth, & Polivy, 2003; Robinson, Blissett, & Higgs, 2013; Robinson, Thomas, Aveyard, & Higgs, 2014; Vartanian, Spanos, Herman, & Polivy, 2015). For instance, laboratory studies show that individuals shift their intake and dietary choices towards those of their dining partners (Robinson, Tobias, Shaw, Freeman, & Higgs, 2011; Salvy, Jarrin, Paluch, Irfan, & Pliner, 2007). Reviews and meta-analyses have confirmed a significant modelling effect even if dining companions are not present and others' intake is indicated by other means, such as a list of what had been eaten by previous participants in the study (Cruwys, Bevelander, & Hermans, 2015; Vartanian et al., 2015). Modelling was also found to be strongest when the individual feels similar to or wants to affiliate with the model (Cruwys et al., 2015). The associations between an individual's eating behaviour and that of others may also go beyond specific dining occasions, reflected in similar eating patterns within social circles (Pachucki, Jacques, & Christakis, 2011). This evidence suggests that individuals rely on their perception of others' eating behaviours to guide their own choices. Consequently, a potential way to encourage people to make healthier dietary decisions is to alter perceived descriptive social norms (i.e., alter people's perception of the decisions that others like them are making).

Manipulating descriptive social norms has shown promise in terms of encouraging fruit and vegetable intake. Perceived social norms have been found to be correlated with self-reported eating habits (Lally, Bartle, & Wardle, 2011; Robinson, 2015), and exposure to social norms suggesting that others are making healthy dietary choices can increase individuals' intentions to do the same (Crocker, Whitaker, Cooke, & Wardle, 2009; Yun, Silk, & Yun, 2016). Further evidence suggests that altering perceived social norms can affect actual behaviour. For example, suggesting that others are eating the recommended number of portions of fruit and vegetables has been found to increase self-reported consumption in students in a week-long field study (Stok, Verkooijen, de Ridder, de Wit, & de Vet, 2014). In addition, Robinson and colleagues (Robinson, Fleming, & Higgs, 2014) found that exposing students to descriptive social norms about relatively high fruit and vegetable intake significantly increased intake of those items at a laboratory-based food buffet, whereas exposure to health messages had no effect on intake. Follow-up analyses indicated that the effect of the social-norm message was observed among low habitual consumers of fruit and vegetables, but not among high habitual consumers of fruit and vegetables. Exposing people to a social norm or a health-related message suggesting that others are eating less junk food (compared to a non-food-related control message) reduced junk-food intake in a laboratory setting (Robinson, Harris, Thomas, Aveyard, & Higgs, 2013). These data suggest that messages conveying health information might therefore be effective in promoting reduced consumption of junk food rather than increased consumption of fruit and vegetables, possibly because people are used to seeing health messages concerning fruit and vegetables, but might be less aware of the health implications of junk-food consumption.

What has been less extensively investigated is whether the effects of social norms can be translated into real-world interventions. Without such investigation, it is impossible to know whether the behaviours and mechanisms at work in laboratory settings translate into real-world dietary change. We are aware of three reports suggesting that findings

from the laboratory may translate to restaurant settings. Mollen, Rimal, Ruiter, and Kok (2013) explored the effect of displaying a healthy descriptive social-norm message ("Every day more than 150 [name of university] students have a tossed salad for lunch here") compared to a no-message condition, a healthy injunctive norm ("Have a tossed salad for lunch!"), and an unhealthy descriptive norm ("Every day more than 150 [name of university] students have a burger for lunch here") in a student restaurant. Mollen and colleagues reported that the healthy descriptive social-norm message significantly increased the self-reported selection of salad over a hamburger option, but only for customers who reported seeing the posters. Using a pre-test/post-test design, Thomas et al. (2017) found that displaying social-norm messages ("Most people here choose to eat vegetables with their lunch") in workplace restaurants was associated with an increase in the overall purchase of meals containing vegetables, an effect that was maintained and then increased during the week after the posters were removed. Finally, Thorndike, Riis, and Levy (2016) found that social-norm feedback (in the form of a letter sent to participants once a month) was associated with a significant increase in healthy food choices, but only when combined with a financial incentive. However, whilst such studies have provided initial insights into the potential real-world effects of social-norm messages, certain questions remain. For instance, field studies conducted to date have compared the effect of social-norm messages to either baseline measurements or to a condition in which no message was displayed. It therefore remains unclear whether social-norm messages are more effective than are health messages, such as those commonly used in healthy-eating campaigns. Because lab studies tend to suggest that social-norm messages are effective above and beyond the traditionally used health messages (Robinson, Fleming, et al., 2014), even if only for low habitual consumers of vegetables (Thomas et al., 2016), this is an important question to test in a real-world context. Similarly, further evidence is required in order to build upon this existing work and establish whether social-norm messages conveyed via posters (rather than by the letters used by Thorndike et al., 2016) have an effect on observed (rather than just self-reported) purchases (as in Mollen et al., 2013).

Our aim here was to explore the effect on observed vegetable purchase of social-norm messages as well as that of health messages in student canteens. We conducted two observational field studies, in order to explore the effectiveness of the intervention on two different outcome measures. In both studies, the purchases of meals in two canteens were observed during a baseline period, an intervention period (in which either a social-norm message or health message was displayed), and a post-intervention period (during which no messages were presented). Study 1 focused on the observation of main meals containing vegetables as an integral ingredient. Study 2 aimed to replicate the findings of Study 1, but examined the purchase of side portions of vegetables. It was hypothesised that (1) introduction of the social-norm message would be associated with increased purchase of vegetables, and (2) the health intervention would have limited impact on vegetable purchases.

## 2. Study 1

### 2.1. Method

#### 2.1.1. Participants

Participants were customers purchasing meals from two canteens serving students on a University campus. Ethical approval was obtained from the University of Birmingham Science, Technology, Engineering and Mathematics Review Committee (Approval code: ERN\_13-0475P). The study was conducted in accordance with the British Psychological Society Guidelines on observational research, and informed consent was not obtained for observation of meal purchases but was obtained prior to the completion of exit surveys by participants.

### 2.1.2. Design

One site was randomly selected to display the social-norm message and the other to display the health message. Within each site, observations were made during three stages, all of which were one week long and occurred in immediate succession: baseline, intervention (during which the posters were displayed) and post-intervention (when the posters were removed). For each of these weeks, observations were conducted on three days (Mondays, Tuesdays and Thursdays), resulting in a total of nine days of observations. Observations were not carried out on Wednesdays or Fridays due to special events and promotions occurring on these days that might have affected purchasing behaviours. The planned analysis of interest was to compare the purchases in the health versus social-norms site during the intervention stage.

### 2.1.3. Sample size

Similar observational studies into the effect of social-norm interventions have generated small effect sizes (e.g. [Burger & Shelton, 2011](#); [Thomas et al., 2017](#)). A power analysis conducted with G-Power 3.1 indicated that a sample size of 785 observations was needed in each condition to detect a similarly small effect (assuming an alpha of 0.05 and power of .80).

### 2.1.4. Materials

**2.1.4.1. Messages.** During the intervention stage, one canteen was randomly assigned to display a social-norm message (“Did you know that most students here choose to eat vegetables with their meal?”), and the other a health message (“Did you know that students who choose to eat vegetables have a lower risk of heart disease?”). These messages were based on similar wording used by [Thomas et al. \(2016, 2017\)](#), and the accuracy of the social-norm message was confirmed by the observations made in the baseline stage of the study. The posters were printed in colour (see [Fig. 1](#)) and were displayed at prominent places in the canteens, including near the menus, in the food-selection areas and on tables.

**2.1.4.2. Canteens.** Two venues were available for this study, both of which were student canteens run by the same catering company. Both of these venues served a variety of hot and cold meals with optional side dishes. The venue displaying the social-norm message was primarily a daytime canteen located on the centre of campus, with

the busiest period occurring over lunchtime (12:00–14:00). The venue displaying the health message was situated near on-campus student accommodation and was open from 16:30–20:00 during the week, with the busiest period occurring from 17:30–19:30. The two venues were approximately 15 min’ walk from one another. For each venue, students queued at the relevant counter, requested their dish and any additional sides from the catering staff, and then purchased their selection at the till-point.

**2.1.4.3. Exit surveys.** In order to collect more information on the customers and to ascertain whether the posters had been seen, we conducted a customer exit survey within the canteens on the last day of each study stage. This was important information to collect because it has been reported previously that the effect of a social norm message is effective only for those who had seen the posters ([Mollen et al., 2013](#)), so knowing if the posters had been noticed would be important in interpreting any null findings. Moreover, the observational nature of the study meant that exit surveys were the only way to ascertain the demographics of the sample.

The survey was distributed on the last day of each study stage rather than throughout the observation period in order to avoid influencing behaviour on subsequent days within that stage. For instance, enquiring as to the visibility of the posters on the first day of the intervention might have artificially increased the attention paid to the messages on subsequent visits. Further to this, the surveys were distributed only to those leaving the venue.

The survey included questions on basic demographic information, including age and gender, as well as questions about habitual daily consumption of vegetables outside of the context of the study. During the intervention stage, the exit survey also included questions regarding the posters. Participants were asked whether they remembered seeing any posters, and if so, whether could remember the text. Participants were also asked to recall the poster messages, and if this answer corresponded with the message displayed in that venue, it was coded as correct. Those who reported the message for the other venue (e.g., those reporting the social-norm message when surveyed at the health-message venue and vice versa) were marked as incorrect.

### 2.1.5. Procedure

For the present study, meals were deemed to contain vegetables if



Fig. 1. The posters displayed in the canteens containing the health-related message (left) and the social norm message (right).



the catering company reported that the meal contained at least one portion (80 g) of vegetables. For each observation day, the catering company informed the researchers which of the meals on offer met this criterion and which did not, in order to enable accurate observations. Whilst the specific meals on offer changed from day to day, the number that met the criterion and the approximate vegetable content of those that did remained consistent. Meals with or without vegetables did not differ in price. No additional information was provided to customers regarding the vegetable content. Two researchers, who were students at the university and were aware of the hypotheses of the study, were positioned at till-points. The researchers independently observed which meals were being purchased, recording whether or not they contained a portion of vegetables. Observations were recorded during the busiest 2-h period at each venue (from 12:00–14:00 for the social-norm venue, and from 17:30–19:30 for the health-message venue). Inter-rater reliability between researchers was high, with a mean Cohen's Kappa coefficient of 0.97 (ranging from 0.93 to 1.00).

### 2.1.6. Analysis

The observation data collected each day were collated and summed for each stage of the study and for each venue. A layered Pearson's Chi-Square test was used to compare the two venues and the three study stages. For the latter, inspection of the standardised residuals enabled the nature of any associations to be identified (Agresti, 2002, 2007). Odds ratios (OR) and confidence intervals (CI) were also estimated as part of the Chi-Square analyses.

## 2.2. Results

During the nine days of observations, a total of 7598 meal purchases were recorded, 3075 in the canteen displaying the social-norm message and 4523 in the canteen displaying the health message. Across the two venues, 5310 (69.9%) of all meal purchases contained vegetables. Details of the observed purchases across the three stages of the study and the two venues may be seen in Table 1.

Seven hundred and four valid exit surveys were collected, 228 (32.4%) from the canteen displaying the social-norm message and 476 (67.6%) from the canteen displaying the health message. Male participants comprised 48.2% of the sample (0.6% responded "other" and the remainder were female), and ages ranged from 18 to 47 ( $M = 19.60$ ,  $S.D. = 2.95$ ).

Demographics across the two sites may be found in Table 2. Habitual vegetable consumption indicates the number of servings of vegetables participants reported eating daily as part of their usual schedule, not just within the canteen.

During the intervention stages, the responses to the exit surveys indicated that a total of 219 participants (45.8%) correctly recalled the displayed message in the health condition (39.5% reported that they did not see any poster), and 118 participants (33.9%) reported the correct message in the social-norm condition (66.1% reported that they did not see any poster). The remaining participants incorrectly recalled

**Table 1**

Observed purchases of meals with and without vegetables and percentages across the three stages of the study and the two venues.

Study Stage	Social-Norm Venue		Health Venue	
	Without vegetables	With vegetables	Without vegetables	With vegetables
Baseline	395 (37.33%)	663 (62.67%)	421 (25.13%)	1254 (74.87%)
Intervention	311 (32.46%)	647 (67.54%)	357 (25.61%)	1037 (74.39%)
Post-Intervention	354 (33.43%)	705 (66.57%)	450 (30.95%)	1004 (69.05%)

**Table 2**

Demographics for each condition, as indicated by responses to the exit surveys.

Condition	N	Age	Gender	Habitual vegetable consumption (servings per day)
		M (SD)	% female	M (SD)
Health	476	18.74 (1.55)	50.8	2.37 (1.49)
Social Norm	228	21.39 (4.12)	52.2	2.01 (1.44)

the poster message. The different recall rates in the two venues may have reflected variance in the layouts of the canteens, and consequently, the positioning (and visibility) of the posters.

### 2.2.1. Analyses

In order to investigate the impact of the messages, a Pearson's Chi Square analysis was conducted. For the first analysis, study stage was entered as a layer variable, and the association between the condition and meal type (with or without vegetables) was tested for each stage. As significant baseline differences in the observed proportion of meals purchased with vegetables were identified between the conditions ( $\chi^2 = 46.09$ ,  $p < .01$ ,  $\Phi = 0.13$ ), meaningful comparisons were not possible. More meals with vegetables were purchased at the health venue. Although it is not possible to identify exactly why such differences were evident, likely explanations are the variations in the meal options available or differences in customer preference. Therefore, rather than analyse the data according to a randomised control design, we analysed the data according to a pre-post-test design within each site. A Chi Square analysis was conducted within each condition in order to explore whether the introduction of either message was associated with changes in purchasing behaviour. Meal type (with and without vegetables) and stage of the study (baseline, intervention, post-intervention) were entered as the experimental variables, with the condition entered as the layer variable. There was a significant association between meal type and stage of the study for the Health condition ( $\chi^2 = 15.72$ ,  $p < .01$ ,  $\Phi = 0.04$ ), and for the Social Norm condition ( $\chi^2 = 6.06$ ,  $p = .048$ ,  $\Phi = 0.06$ ). Post-hoc tests in the form of inspection of standardised residuals enabled us to identify the nature of these associations. This is indicated by standardised residuals of  $> 2$ , which suggest significant deviations from the value expected given an even distribution, in the absence of any association between the two variables (Agresti, 2002, 2007).

For the Social Norm condition, the residuals indicated that the introduction of the posters was associated with a significant increase from the baseline (63% of meals purchased containing vegetables) to the intervention (68%; OR = 1.24, CI = 1.03–1.49) which was sustained in the post-intervention stage (67%; OR = 0.96, CI = 0.80–1.15 – see Fig. 2). In the Health condition, the proportion of meals purchased with vegetables did not increase between the baseline (75%) and intervention stage (74%; OR = 0.98, CI = 0.83–1.15); the significant Chi Square statistic was instead attributable to a decrease in the proportion of meals purchased containing vegetables in the post-intervention stage compared to a higher baseline (69%; OR = 0.75, CI = 0.64–0.88), suggesting no positive impact of the health posters.

## 2.3. Discussion

Study 1 explored whether introducing a social-norm message or a health message in a student canteen setting was associated with increased purchase of meals containing vegetables. We found that the introduction of the social-norm posters was associated with a significant increase in the proportion of meals purchased containing vegetables, which was sustained in the post-intervention stage. However, there was no such increase in the health-message intervention.

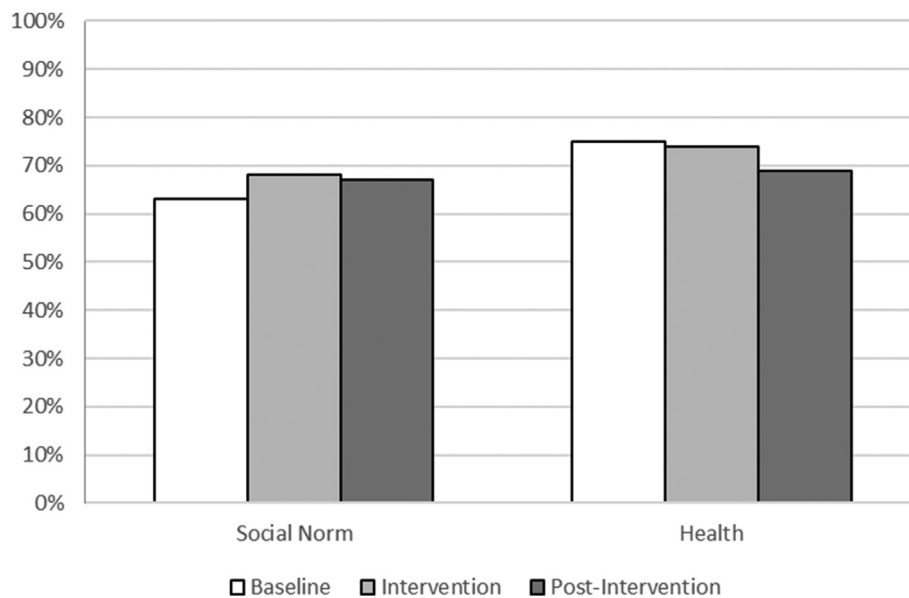


Fig. 2. Percentages of meals purchased containing vegetables in the two canteens across the three stages of the study.

Although the large baseline differences prevented us from making a direct comparison between the conditions, the finding that the introduction of social-norm messages is associated with increased vegetable purchases relative to a no-message baseline is in line with previous work from laboratory-based studies (Robinson, Fleming, et al., 2014) and other field work (Mollen et al., 2013; Thomas et al., 2017).

### 3. Study 2

The aim of Study 2 was to replicate and extend the findings of Study 1. The focus in Study 1 was on meals that contained a portion of vegetables as an integral part of the dish, as was the case in the study by Thomas and colleagues (Thomas et al., 2017). However, in the study by Thomas and colleagues (Thomas et al., 2017) it was also possible to assess the effect of the social-norm message on the purchase of side portions of vegetables, because this information was recorded at the till. For Study 2, we decided to examine whether a similar effect of the social-norm intervention might be observed when participants are explicitly purchasing a side portion of vegetables, as we reasoned that the intervention may be more likely to affect purchases that more explicitly contain vegetables. It is not always clear which main meals contain a full portion of vegetables, whereas all side portions clearly do.

The design of Study 2 also addressed some of the limitations of Study 1. The exit-survey responses for Study 1 indicated that the majority of those surveyed did not see any posters. It is possible that the messages may have affected behaviour even though the participants were unable to recall seeing the posters. For example, it has been reported that olfactory stimuli can affect food choices even though participants report being unaware of presence of the odours (Chambron, Chisn, Chabanet, Issanchou, & Brand, 2015). However, as previous work has found social-norm messages to be effective only for those who reported seeing and correctly remembering the messages (Mollen et al., 2013), it was important to establish whether our low recall rates were due to a lack of visibility of the posters or the manner in which we asked the question. Because we asked an open question about the posters, the participants were not necessarily prepared to spend time answering the question and hence often left it blank or gave only a one- or two-word response. This issue was addressed in Study 2 by using a multiple-choice-question format.

In Study 1, at baseline, there were more meals purchased with vegetables in the health-intervention canteen than in the social-norm canteen. This difference in the baseline level of vegetable purchases

may have been related to the different characteristics of the canteens. Although the types of meals served in the canteens were similar and the customers at both venues were students, it may have been that the higher percentage of customers purchasing meals with vegetables in the health-condition canteen reduced the likelihood of seeing an intervention effect (i.e., a ceiling effect). There was also a relatively short observation period of one week per stage which might also have precluded detection of significant effects. Therefore, we sought to repeat the study in a different canteen that also served mainly at lunchtime, while extending the observation period for each stage to two weeks. Finally, given that the increase in vegetable purchases associated with the social-norm intervention was relatively small (around 5%), we reworded the social-norm message to highlight a shared identity between the customers and the referent group, which we hypothesised might enhance the message's effectiveness (Stok et al., 2014). We hypothesised that exposure to social-norm messages would be associated with an increase in the purchase of side portions of vegetables whereas exposure to a health message would not be associated with increased vegetable purchases.

#### 3.1. Method

##### 3.1.1. Participants

As in Study 1, participants were customers of two student canteens on a University campus. Ethical approval was obtained from the University of Birmingham Science, Technology, Engineering and Mathematics Review Committee (Approval code: ERN\_13-0475P). The study was conducted in accordance with the British Psychological Society Guidelines on observational research, and informed consent was not obtained for observation of meal purchases. However, informed consent was obtained prior to the completion of exit surveys by participants.

##### 3.1.2. Design

The same design as in Study 1 was used but observations were made across a two-week baseline stage (consisting of a total of five days of observations), a two-week intervention stage (consisting of six days of observations), and an immediate two-week post-intervention stage after the posters were removed (consisting of five days of observations). Observations were conducted on Mondays, Wednesdays and Thursdays. These days were chosen due to special promotions occurring at one or both of the venues on Tuesdays and Fridays that restricted the

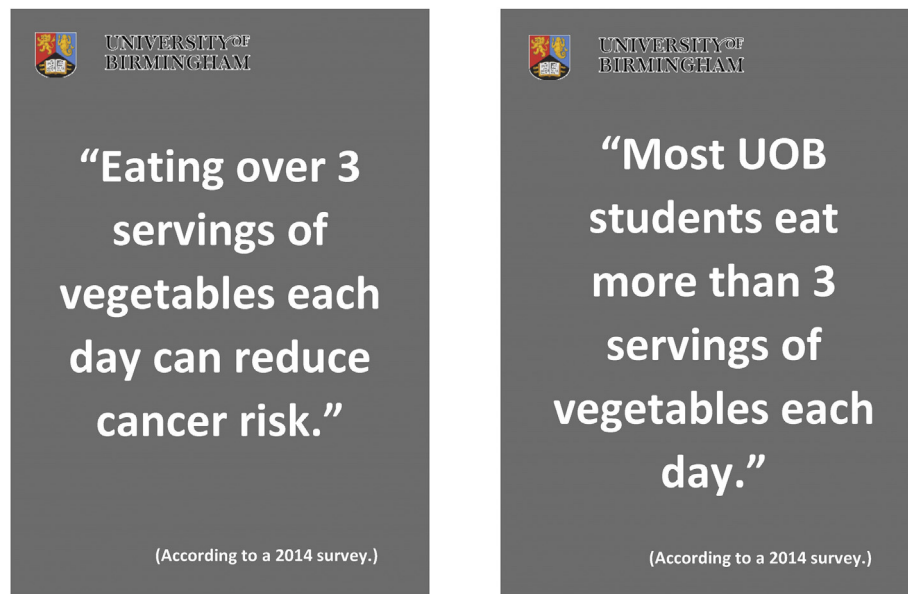


Fig. 3. The posters displayed in the canteens containing the health-related message (left) and the social norm message (right).

vegetable options available to customers. The only exceptions to this were the first week of the baseline stage, and the final week of the post-intervention stage, for which observations were conducted only on the Wednesday and the Thursday of that week due to events held on those days. This resulted in a total of 16 days of observations.

### 3.1.3. Sample size

In line with our power analysis for Study 1, 785 observations per condition was the minimum requirement to detect the expected small effect size.

### 3.1.4. Materials

**3.1.4.1. Messages.** As in Study 1, during the intervention stage, one canteen displayed a social-norm message (“Most UOB [University of Birmingham] students eat more than 3 servings of vegetables each day, according to a 2014 survey”), and the other a health message (“Eating over 3 servings of vegetables each day can reduce cancer risk, according to a 2014 survey”). As before, posters were displayed at prominent places in the canteen, including near the menus, in the food-selection areas, and on tables (see Fig. 3).

**3.1.4.2. Canteens.** As in Study 1, the two canteens employed were situated on a University campus, and were owned by the same catering company. Both venues served a variety of hot and cold meals with optional side dishes. One of the canteens used in the present experiment had also been used in Study 1 (as the venue displaying the social-norm message), although in the present study, that canteen displayed the health message. Further to this, Study 2 was conducted in a different academic year than was Study 1, and therefore, participants were not all from the same cohort as Study 1. If any participant in Study 2 had been exposed to the messages in Study 1 this exposure would have occurred at least one year prior to participation in Study 2.

Both venues were primarily daytime canteens, with the busiest hours occurring between 11:30 and 13:30. The venue displaying the social-norm message was located on the outer edge of campus, approximately a 10–15 min walk from the venue displaying the health message. For each venue, students queued at the relevant counter, requested their dish and any additional sides from the catering staff, and then purchased their selection at the till-point. To keep observations as consistent as possible between the two canteens, only meals purchased from equivalent counters that offered the option of side portions of vegetables were included.

**3.1.4.3. Exit surveys.** An exit survey similar to that used in Study 1 was administered to customers within the canteens on the last day of each study stage. The first section of the questionnaire requested basic demographic information, including age, gender, and ethnicity, as well as the number of portions of vegetables habitually consumed per day, outside of the context of the study.

During the intervention stage, there was also a question asking participants whether they had seen any posters. If they had seen a poster, they were subsequently asked to circle one of two options: either the health poster or the social-norm poster. If they had circled the poster that had been displayed at that site, this was marked as correct.

### 3.1.5. Procedure

As in Study 1, at each of the sites, two researchers who were students at the university and aware of the hypotheses of the study were positioned by the till-points. The researchers independently observed whether customers purchased their meals with or without side portions of vegetables (excluding any potato products). Side portions of vegetables were dispensed by the catering staff, and therefore constituted at least a portion (80 g) of vegetables. Side portions of vegetables were sometimes purchased separately (at additional cost) or were included as part of the meal. When included in the price, customers had a choice between side portions of vegetables or fried potato products. Accordingly, regardless of whether side portions were included in the price or as an additional purchase, side portions of vegetables were served only when requested by customers. The observations were made during the busiest periods at the canteens. For both canteens, this time was between 11:30 and 13:30. Inter-rater reliability was high, with a mean Cohen's Kappa coefficient of 0.96, ranging from 0.91 to 0.99.

### 3.1.6. Analyses

As in Study 1, the data collected on each of the observation days were collated and summed for each stage of the study (baseline, intervention, and post-intervention) and for each venue. A layered Pearson's Chi-Square test was used to compare the two venues and the three study stages. The standardised residuals were inspected to identify the nature of any associations. Odds ratios (OR) and confidence intervals (CI) were also calculated where appropriate.

**Table 3**

Total numbers of meals observed with and without side portions of vegetables and percentages across conditions and stages of the study.

	Health		Social Norms	
	Vegetables	No vegetables	Vegetables	No vegetables
Baseline	256 (43.84%)	328 (56.16%)	133 (22.93%)	447 (77.07%)
Intervention	447 (52.84%)	399 (47.16%)	293 (32.48%)	609 (67.52%)
Post-Intervention	278 (48.10%)	300 (51.90%)	124 (22.06%)	438 (77.94%)

### 3.2. Results

#### 3.2.1. Descriptive

A total of 4052 meals were observed, averaging 253 per day across the two sites. A total of 1531 of these meals were purchased with extra portions of vegetables. A breakdown of the number of meals observed for each condition and stage of the study may be found in Table 3.

A total of 481 completed exit surveys were collected on the last day of the baseline ( $n = 98$ ), the intervention ( $n = 171$ ) and the post-intervention stages ( $n = 212$ ). The respondents ranged in age from 18 to 56 ( $M = 20.75$ ,  $S.D. = 4.10$ ), and 311 (64.7%) were female. The breakdown of demographics across the two conditions can be found in Table 4.

During the intervention stage, a total of 80.7% of respondents correctly identified the poster, with 1.8% selecting an incorrect poster and 17.5% indicating that they had not seen any poster at all. At the canteen displaying the social-norm message, 90.1% of exit survey respondents saw and correctly remembered the poster, compared to 70% at the health-message canteen.

#### 3.2.2. Analyses

In order to compare the two messages directly, a Chi Square analysis was conducted on meal type (with or without side portions of vegetables) and condition, with study stage as a layered variable. Once again, there were significant differences between the two canteens at all stages of the study, including the baseline ( $\chi^2 = 57.15$ ,  $p < .01$ ,  $\Phi = -0.22$ ). These baseline differences prohibited confidently comparing the effect of the social-norm and the health messages. We therefore conducted analyses within the sites, as in Study 1. This took the form of conducting a layered Chi Square analysis on meal type (with versus without side portions of vegetables), and study stage, with condition as a layered variable.

There were significant associations between study stage and meal type for the social-norm condition ( $\chi^2 = 16.18$ ,  $p < .01$ ,  $\Phi = 0.09$ ) and for the health condition ( $\chi^2 = 11.39$ ,  $p < .01$ ,  $\Phi = 0.08$ ). As in Study 1, to establish where these significant associations occurred in terms of the study stages, we examined the adjusted standardised residuals for any exceeding a value of 2, which indicate significant deviations from the expected values in the case of no association between the variables. In the social-norm condition, the residuals indicated that there was a significant increase in the proportion of meals purchased with additional portions of vegetables from the baseline (22.9%) to the intervention stage (32.5%;  $OR = 1.62$ ,  $CI = 1.27$ – $2.05$  – see Fig. 4).

**Table 4**

Demographics for the two conditions/canteens according to the exit surveys collected across all stages of the study.

Condition	N	Age	Gender	Habitual vegetable consumption (servings per day)
		M (SD)	% female	M (SD)
Social Norms	267	20.14 (3.75)	73.0	2.87 (1.86)
Health	214	21.52 (4.38)	54.2	2.64 (2.52)

This increase was not, however, sustained in the post-intervention stage, in which the proportion declined to 22.1% ( $OR = 0.59$ ,  $CI = 0.46$ – $0.75$ ). For the health condition, the residuals indicated that the proportion of meals with additional portions of vegetables increased from baseline (43.8%) to the intervention stage (52.8%;  $OR = 1.44$ ,  $CI = 1.16$ – $1.77$ ). There was no change between the intervention and the post-intervention stage (48.1%;  $OR = 0.83$ ,  $CI = 0.67$ – $1.02$ ).

### 3.3. Discussion

The current work investigated the association between displaying social-norm messages and health messages and the purchase of meals containing vegetables (Study 1) and the purchase of side portions of vegetables (Study 2). In Study 1, we observed that the display of social-norm messages (but not health messages) was associated with an increase in the purchase of meals containing vegetables. In Study 2, exposure to both the social-norm and health messages was associated with an increase in the purchase of side portions of vegetables. In addition, although there was no difference in the number of meals purchased with vegetables during the intervention versus the post-intervention stage in Study 1, the removal of the social-norm posters, but not the health posters, was associated with a decrease in purchases of side portions of vegetables in Study 2. Therefore, the findings overall are mixed and some caution is required in interpreting the results, especially because although it was our original intention to directly compare purchases across the message conditions, differences in baseline purchases precluded such analysis and so we were able to compare purchases only within sites according to a pre-post-test design. However, we did observe that exposure to the social-norm message was associated with an increase in vegetable purchases across both studies. An important conclusion is that any further testing of the effects of social-norm messages on purchases of vegetables in canteen settings should involve testing at multiple sites to reduce the influence of variability between venues.

The results of the present studies, alongside those of a previous study in a workplace restaurant (Thomas et al., 2017), provide some tentative support for the suggestion that social-norm-based messages may be associated with a small increase in purchases of vegetables in a field setting, and one that is not restricted to specific populations. However, this conclusion must be tempered by two additional findings reported here: 1) that purchases in the post-intervention phase differed across studies and 2) there was also an effect of the health message in Study 2. There are several possible reasons for this pattern of results. One explanation is that the pattern is attributable unrelated changes in sales during those weeks. This could be addressed in future studies by the inclusion of a no-treatment control group (e.g. displaying posters with non-vegetable content, or no posters at all), which was not possible in the present study because of the limited number of available venues.

A second possibility is that the pattern of results is explained by changes in the customer base across the different phases of the study, as we did not follow individual customers across the three stages of the study. Although it is likely that students regularly visit the same venues, identifying whether purchasing behaviour changed during the intervention on an individual level would have allowed us to draw stronger conclusions. In the present studies, it was not possible to follow



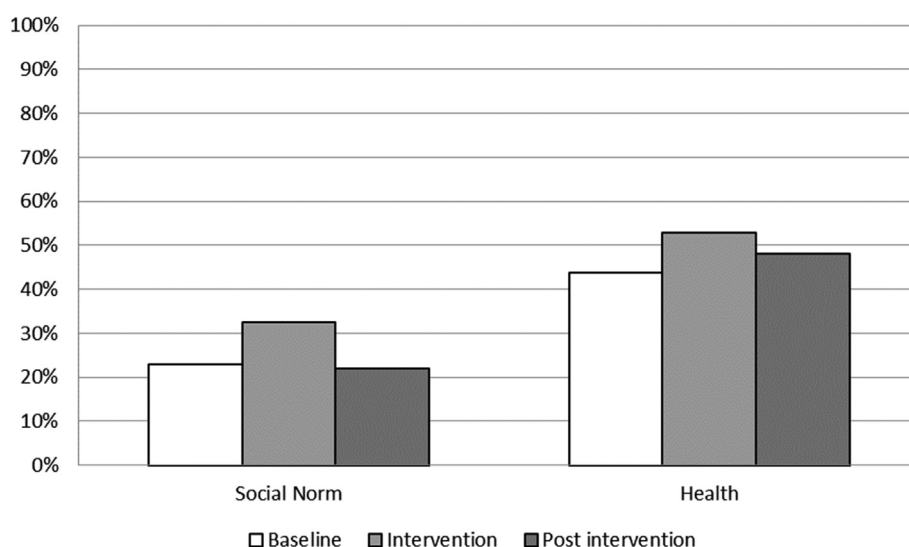


Fig. 4. Percentages of meals purchased with side portions of vegetables in the two canteens across the three stages of the study.

individual customers, and it is therefore unclear whether they were involved in multiple stages of the studies. The introduction of electronic forms of payment that allow individual customers' purchases to be logged may allow for future research to tie together purchases from specific individuals across the different stages of the study. Such an approach would also be able to identify whether there were participants who attended both venues and thus were exposed to both messages, which is a possibility that we cannot rule out in the present studies. A related limitation is the possibility that some participants may have taken part in both studies. However, as Study 2 was conducted one year after Study 1, it seems unlikely that the message would have been remembered. The observational nature of the present studies also meant that participants from Study 1 were not debriefed, and therefore would not have known the aims of our research. Consequently, whilst it would be interesting to know if any customers were present for both Study 1 and Study 2, participation in both studies is not likely to have had a substantial impact on our observations.

A final interpretation of our findings is that the pattern of results is related to the posters but 1) any effect of health-based messages is variable and/or specific to purchases of side portions of vegetables (as observed in Study 2) and/or 2) the variability in the maintenance of any social-norm effect is due to differences in the methods used in Study 1 versus Study 2.

If it is the case that the pattern of results reflects a true effect of social-norm messaging to increase the purchase of vegetables, then it is important to also consider the size of the effect, which was a 5–10% increase. Although this represents a relatively small increase in the purchase of vegetables, the approach has the advantage of being inexpensive.

A further unanswered question is whether this approach would be effective for other populations. University students offer an interesting case study in interventions for healthy eating, as they have been reported to eat few fruits or vegetables (Brevard & Ricketts, 1996; Racette, Deusinger, Strube, Highstein, & Deusinger, 2005), largely due to habit (de Bruijn, 2010). This makes healthy interventions for students both necessary and timely; altering habits at the transition to University can mean that more healthy habits are established early on in adulthood. In addition, there is evidence that adolescents and young adults are more sensitive to peer influence and peer pressure than are older adults (e.g. Pasupathi, 1999). An interesting focus for future research would be to expand our approach to other populations (beyond workplaces as in Thomas et al., 2016), for instance individuals of lower socioeconomic status. There is emerging evidence that information-based interventions may serve to worsen inequalities in diet and health

(Adams, Mytton, White, & Monsivais, 2016), making the creation of effective interventions for this group even more pressing. Should future studies also establish that actual consumption of purchased vegetables is increased by such messages, then there is the potential for clinically significant health effects. This is especially pertinent given that consumption of an additional vegetable serving per day has been associated with a 5% reduction in all-cause mortality (Wang et al., 2014).

The development of future interventions based on social-norm messages would also benefit from a full understanding of how and why they are effective. Studies conducted in the lab have already begun to clarify the underlying mechanisms of perceived or communicated social norms and their impact on dietary choices in the lab (e.g. Kaisari & Higgs, 2015; Robinson & Higgs, 2012, 2013; Robinson et al., 2014; Robinson et al., 2011). Future work may therefore wish to further test these mechanisms in real-world settings.

In conclusion, across two real-world, observational studies conducted in student canteens we observed that the presentation of social-norm messages was associated with a small effect on increased purchases of meals containing vegetables (Study 1), and side portions of vegetables (Study 2), whereas the introduction of a health message was associated only with an increased purchase of side portion of vegetables. This is one of the first attempts to test the effects of such messages in real-world contexts. Limitations of the study design prevent us from being able to rule out alternative explanations for the overall pattern of results and so we conclude by suggesting that any further tests of social-norm approaches to encouraging healthier eating must now involve larger-scale testing at multiple sites using a randomised controlled design.

## Abbreviations

OR: Odds Ratios; CI: Confidence Intervals; M: Mean; SD: Standard Deviation

## Declarations

### Consent for publication

Not applicable.

### Availability of data and material

The dataset supporting the conclusions of this article are archived with the ReShare UK Data Archive.

## Competing interests

All of the authors declare that they have no competing interests.

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## Author's contributions

All authors contributed to the design of the research. JT and EC oversaw the data collection, which was analysed by EC. EC and SH drafted the paper and all authors critically reviewed and improved it. The University of Birmingham Catering department managing the canteens was not involved in the study design process, analysis of results, or the write-up of the paper.

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